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PREDICTION AND MANAGEMENT AS A SINGLE SYSTEM

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*<u>ye</u> initially, after vowels, and after ъ, ь; <u>e</u> elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

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GRAPHICS DISCLAIMER

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RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}

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rot	curl
lg	log

Nesterov, V. (USSR)

PREDICTION AND MANAGEMENT AS A SINGLE SYSTEM

Only highly externalized phenomena can be adequately predicted by means of formulas which express dynamic relationships; in more complex situations prediction must be made on a diatopic basis, viewing the state of the system as a function of surrounding factors acting on it. Interrelationships between output and input (y) of the system in a diatopic expression takes on the following form:

$$Y_l(t) = \sum_{k=1}^{n} \int_{-\infty} w_{lk}(t-\tau)\, x_k(\tau)\, d\tau, \quad y'\tau > t \geq 0,$$

where l = 1,2, ..., m -- output;

k = 1,2, ..., n -- input;

W_{ek} -- weighting functions.

As an expression of degree of autonomy of the system from the environment, the criterion of the ideal can be used

$$k_d = 1 - \sqrt{1 - \frac{\sum_i \varphi\left[(x_1 - x_1^i), \ldots, (x_n - x_n^i)\right] (y_l - \hat{y})^2}{\sum_i \varphi\left[(x_1 - x_1^i), \ldots, (x_n - x_n^i)\right] (y_l - \bar{y})^2}},$$

where $y_1(t)$ -- state of real constant (for living systems this is the water content of the organism, the body temperature, bioelectrical potential, etc.);

$x_k(t)$ -- state of environmental factors, such as solar radiation, humidity, etc.

For technical systems, for example,

$y_1(t)$ -- given temperature (in a smelter, or a refrigerator); a given velocity (for a plane or rocket), etc.;

$x_k(t)$ -- energy supply, ventilation, etc.;

k_d -- indicator of the systems completeness (autonomy).

The accuracy of the prediction increases when the relationship between the scientific solution at a given time and the possible practical application in the future is considered--the system "Start--saturation" ('stasata')

The stasata system assumes a succession of the following events to be accomplished.

1. Setting a goal, considering the possible costs and efficacy and the interrelationship between them.

2. An actual prediction by means of the 'start-saturation' system.

3. A search for the optimal solution to the problem by means of an excess of solutions, considering the effect of the relationship of the past to the present.

Attainment of these stages is the condition for the accomplishment of the stipulated goal, for example, provision of the necessary protein and sugar concentration in plant and animal bodies, guarantee of the desired velocity for a machine designed for labor productivity, etc. (y).

In agriculture, for example, this can be a concrete combination of pure and hybrid strains of various plants, in medicine a decrease in cardiovascular disease, an increase in the human life-expantancy to 100 years. The functioning of the prediction and management system under discussion assumes the review of input information on the characteristics of possible methods, types and constructions of machines, forms of labor organization, forming the multiplicity of elements (x) which can be used to accomplish a given concrete goal.

The optimization of a decision consists of determining the algorithm of some optimal relationship between efficacy (C_2) and costs (C_1).

Optimal conditions within a range of circumstances can be expressed by the formula ($\frac{dC_2}{dC_1} = 1$, $C_2 > C_1$), which corresponds to the maximization of pure gain in general, or by the expression corresponding to the maximization of efficacy (gain) per unit of cost (capital outlay); the expression corresponds to the criterion for optimal conditions, figured without considering any cost (C_0), a situation which often arises to some degree when natural resources are being exploited and sometimes even in industry. Other types of criteria for optimal conditions are possible.

By using the approach given, a living systems cybernetics laboratory can work out a mathematical description of several systems (taking into consideration the interrelationships) and use it for prediction of these systems' future state. The interrelationships among man, photosynthesis,

environmental productivity and population growth were studied. Social, cultural, and physical factors were accounted for.

From the point of view of the diatopic approach, life is the support of the real constant at a relatively stable level in the face of all possible changes in the environment. Organisms, in the broad sense of the term, live, for practical purposes, within the framework of the bioecos, that is, the optimal combination of organisms (bios) and environmental conditions (ecos). In the 'organism--environment' system at the bioecos level, life expectancy and stable, high productivity are maximal.

In general, the diatopic relation of the real constant (B-bios) of life (body temperature, water content, bioelectric potential, etc.) and ecological parameters (O - ecos) (solar radiation, humidity of the atmosphere, nutrition, etc.) are determined by operators (R) which characterize heredity at stages or generations of development (T_j; T_{n+1}). This configuration of processes is expressed by the formula

$$B(t) = \sum_{j=1}^{n} R_j \left\{ \int_{T_j} O_j(\tau)\, d\tau \right\} + R_{n+1} \left\{ \int_{T_{n+1}} O_{n+1}(\tau)\, d\tau \right\}$$

$$T_{n+1} = (t_{n+1}, t).$$

The external energy flow ($O = \frac{dO}{dt}$) can be correlated to the level of the

$$\left[\frac{dO}{dt}\right]_c = \frac{1}{n+1} \left[\sum_{j=1}^{n} \sum_{i=1}^{m} R_{ij} \left\{ \frac{1}{T_j} \int_{T_j} \left(\frac{B_i^0 - B_i}{B_i^0} \right) dt \right\} + \right.$$

$$\left. + \sum_{i=1}^{m} R_{i_{n+1}} \left\{ \frac{1}{T_{n+1}} \int_{T_{n+1}} \left(\frac{B_i^0 - B_i}{B_i^0} \right) dt \right\} \right].$$

(B_o--fixed level, B--changing state of life.)

The autonomy of a life system with relation to its environment can be determined by means of the criterion 'magnitude of the real constant'.

The conditions for life or an organism improve as there is increasing similarity (but not complete) between temperature (Q), water content (V), chemical composition (N,P,K), of the organism and temperature (Q_*), humidity (V_*), and chemical composition (N_*, P_*, K_*) of the surrounding environment.

The difference between these two categories of factors can be viewed as the basic characteristics of the bioecos. In the first expression the relationship between the characteristics of the organism (B) and the conditions of life $O = [(Q-Q_*), (V-V_*), (N-N_*), (P-P_*), (k-k_*) \ldots]$ can be characterized with the help of the weighted functions (k_Q, k_V, k_N, k_P, k_k ...).

To reduce the indicators characterizing inorganic environment to a form comparable with the indicators of the bios, the operator R_{OB} is used.

The correlation between the ongoing state of the i aspect of B_i and the optimal state of B_o has the following form: $B_i = B_o - R_{OB}$ $[k_Q (Q_i - Q_*) + k_v(V_i - V_*) + k_N(N_i - N_*) + k_p(P_i - P_*) + k_k(k_i - k_*) \ldots]$.

In daily practice the proposition that the closer the physical and

chemical characteristics of the organism and environment are the better seems indisputable. Actually complete equality of these two sets of factors eliminates the work of the regulating organs (stomata of leaves, liver, etc.) and deterioration of the organism occurs. This principle implies that there is a certain difference between the bios and the environment. This difference can be optimal. Optimization of the aggregate difference is equivalent to creation of the optimal bioecos. These differences taken as a group are equivalent to the range of abilities of life systems.

Also in some bioecoses where life expectancy is not relevant, minimization of these differences can be economically desirable.

The concept discussed of the range of abilities of a system, with its predictive implications, can be used to characterize both technical and economic systems as well as biological ones.